CITY OF HAYWARD

STAFF REPORT

AGENDA DATE 05/28/03

AGENDA ITEM 4

TO: Route 238 Working Group

FROM: Director of Public Works

SUBJECT: Glossary of Transportation Terms and Traffic Modeling

As requested by the Group, attached is a glossary of selected transportation terms along with an expanded description of traffic modeling procedures.

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Attachments: Glossary of Transportation Terms

Glossary of Transportation Terms

Annual Average Daily Traffic – The average 24 hour volume, being the total number during a stated period divided by the number of days in that period. Unless otherwise stated, the period is a year. The term is commonly abbreviated as ADT or AADT.

Delay – The time lost while traffic is impeded by some element over which the driver has no control.

Density – The number of vehicles per kilometer on the traveled way at a given instant.

Design Volume – A volume determined for use in design, representing traffic expected to use the highway. Unless otherwise stated, it is an hourly volume.

Diverging – The dividing of a single stream of traffic into separate streams.

EMME/2 – The name of a travel demand model software.

Forecasts – These are the estimates of the number of cars to use a particular roadway or network of roadways in the future.

Grade Separation – This term refers to the vertical separation of two roadways where one roadway passes under or over the other.

Headway – The amount of time between successive vehicles. This term is used both for passenger vehicles moving along a roadway (where headways may be short, such as one second) and for buses (where headways may be 30 minutes or more).

Level of Service (LOS) – This term refers to a grading system for roadways developed by the Transportation Research Board. The grades vary from LOS A (the best conditions) to LOS F (the worst conditions), and are typically based on delay (in seconds per vehicle). The City of Hayward uses the calculation methodology from the 1994 Highway Capacity Manual (other jurisdictions may use earlier or later versions of the manual).

Merging – The converging of separate streams of traffic into a single stream.

Operations – This is the term used for how vehicles interact with one another. Our evaluation of "traffic operations" means we will calculate or measure, for example, the amount of time drivers are typically delayed, given certain circumstances.

Peak Hour – This is the hour of the day in which the highest number of vehicles passes a certain point. Typically, we evaluate morning (AM Peak Hour) and evening (PM Peak Hour) conditions that correspond to commute traffic times.

Ramp Metering – A traffic management strategy which utilizes a system of traffic signals on freeway entrance and connector ramps, to regulate the volume of traffic entering a corridor, in order to maximize the efficiency of the freeway and thereby, minimize the total delay in the transportation corridor.

Running Time – The time the vehicle is in motion.

Spacing – The distance between consecutive vehicles in a given lane, measured front to front.

Speed –

(a) *Design Speed* – A speed selected to establish specific minimum geometric design elements for a particular section of highway.

(b) *Running Speed* – The speed over a specified section of highway, being the distance divided by running time. The average for all traffic or component thereof, is the summation of distances divided by the summation of running times.

Traffic Control Devices –

(a) *Traffic Markings* – All lines, words, or symbols, except signs, officially placed within the roadway to regulate, warn, or guide traffic.

(b) *Traffic Sign* – A device mounted on a fixed or portable support, conveying a message or symbol to regulate, warn, or guide traffic.

(c) *Traffic Signal* – A power operated traffic control device except signs, barricade warning lights, and steady burning electric lamps, by which traffic is regulated, warned, or alternately directed to take specific actions.

Traffic Model – A computer program that calculates estimates of traffic conditions. More specifically, a travel demand model, like EMME/2, estimates the number of cars that will use roadways in the future, while a microsimulation model, like VISSIM, predicts how those cars will move along the roadways relative to one another.

Traffic demand models are frequently used in transportation planning. A model is a mathematical way of describing the structure, performance, and behavior of the physical transportation system. For future description see the attached Description of Traffic Modeling Procedures discussion.

VISSIM – The name of a microsimulation computer traffic model software that is used to analyze and evaluate traffic operations along arterial and local roadways, freeways and highways, and interchanges.

Volume – The number of vehicles passing a given point during a specified period of time.

Weaving – This term refers to vehicle movements where vehicles in the right lane(s) are moving to the left and vehicles in the left lane(s) are moving to the right.

Description of Traffic Modeling Procedures

A traffic model is, by definition, a simplification of the real world into a more manageable number of variables that can be analyzed. Although a model cannot provide all answers, or cannot provide all answers perfectly, they do provide results that are meaningful in planning major transportation improvements. More specifically, a travel demand model, like EMME/2, estimates the number of cars that will use roadways in the future, while a micro simulation model, like VISSIM, predicts how those cars will move along the roadways relative to one another. The sophisticated computer programs, such as EMME/2 and VISSIM, emulate a mathematical way of describing the structure, performance, and behavior of the physical transportation system through many detailed tasks.

Before forecasting future travel, an inventory study is performed to establish relationships among travel choices and other variables in the existing transportation system. Second, the model is "calibrated" to reproduce the current observed travel behavior as accurately as possible. The model forecasts are compared, usually on a street-by-street basis, with known traffic counts taken sometime within the past few years. If the model estimates are reasonably close, the model is ready for use in forecasting future volumes. If the estimates are too large, then further work is done on the model (step one) until an acceptable level of confidence is achieved.

The types of input data needed for travel models include present and future projections of the number of houses and apartments, the square footages of commercial development (by type of use), and other similar land use data. On the supply side, present and future variables describing the street system are also required, such as where roads are located, how fast cars can drive on them, how many lanes are provided, and so forth. If the model includes a transit mode split component (a calculation estimating the percentage of people who choose to take transit), characteristics of available transit are also included.

Transportation Network Assumptions

The transportation system consists of "networks" of connected streets that represent the various routes available for travel. One of the key strengths of travel models is that they consider more than one possible route between any two points. Just as in the real world, when one of the routes becomes congested (due to other vehicles using the route), the model will shift traffic over to another, faster route.

Networks in the model are defined by nodes (intersections) and links (streets) that collectively represent a geometric abstraction of the transportation system identifying all possible travel routes in the study area. Typically, not every street segment or intersection is represented in the model, only the important ones that carry non-local travel. This is primarily done to limit the amount of data required. However, sometimes an attempt is made to model many of the less important streets in the study area in order to assess the impacts of traffic that might filter through neighborhoods.

Traffic Zones

The model geographically divides the region into smaller areas called traffic zones (or sometimes, traffic analysis zones, TAZs). The zones are similar in concept to postal ZIP codes or census tracts. The zones vary in size depending on the intensity of activity, the nature of the land use within the zones, and the level of detail required in the analysis. Generally, the zone borders are defined by natural boundaries (e.g., ridges, creeks), or by man-made barriers (e.g., major streets, railroad tracks).

Each traffic zone produces and attracts a certain number of trips to it, which is calculated using trip generation rates that are based on actual studies of the traffic generating characteristics of a given type of land use. Each zone is represented as a single point in the network, which can be thought of as the zone's "center of gravity," or centroid. All trips begin or end at a centroid. The centroid is connected to the street system using one or more links called centroid connectors. The physical analogies to these links are the local (residential) street system, or driveways to major office/retail developments.

Modeling Procedures

The modeling process can conveniently be divided into three or four steps, depending on whether transit forecasts are part of the specific model: trip generation, trip distribution, transit mode split (if present in the model), and trip assignment. In the first (generation) step, the land use information is converted into vehicle trips using a set of known relationships. For example, on average, single-family homes generated about five round trips (10 one-way trips) each weekday. In the second step, the model determines how the trips are distributed among various competing destinations. For example, what share of trips will be made to a small shopping center that is only a five-minute drive away, versus a larger center that takes 15 minutes to drive to? The third step, calculating an estimate of how many people would take transit, is not part of every model, as some cities or counties choose instead to use a generic percentage of transit users that may be provided through census or other data.

In the last step, assignment, trips are assigned or routed along particular roads or paths that connect various zones. The model assumes that people want to travel via the quickest (shortest time) route possible. However, if everyone used one route, it would become very congested and slow, so the model makes allowances for the relationship between the volume of cars on the route, and the travel speeds.

Modeling Accuracy

The results from the model are typically accurate to within 10 to 20 percent on a given street, given an accurate land use plan. However, it is not uncommon in the real world to observe daily traffic variations of “plus or minus 20 percent” on city streets or highways.

Therefore, this level of accuracy is sufficient to determine important features of the road, such as, how many lanes should be provided? Will the road be of local character, or will it be a collector or arterial street? This is the reason why travel modeling has achieved widespread acceptance in the transportation planning community, and why it is being applied for many different uses.